

ADS/CFT: A STRINGY PILGRIMAGE TO NON-ABELIAN GAUGE THEORY

Department of Particle Physics
University of Santiago de Compostela

A LAICAL PILGRIMAGE

Santiago de Compostela has been part of another *European network* since more than a thousand years ago



It also dealt with the constituents and fundamental forces of the Universe, in a broader sense...

Today, I will briefly introduce the activity of our group of research, a stringy pilgrimage to non-Abelian gauge theory

MEMBERS OF THE GROUP



Faculty

Javier Mas

Alfonso V. Ramallo

José M. Sánchez de Santos



Ramón y Cajal Fellow

José D. Edelstein



Postdocs

Paolo Merlatti

Jonathan Shock

Dimitrios Zoakos



PhD Students

Daniel Areán

Felipe Canoura

Javier Tarrío

Eduardo Conde

RELATED GROUPS IN SANTIAGO

Field theory and integrable systems

J. Luis Miramontes

Joaquín Sánchez-Guillén

Christoph Adam

Paolo Grinza

Heavy ion collisions and QCD Phenomenology

Néstor Armesto

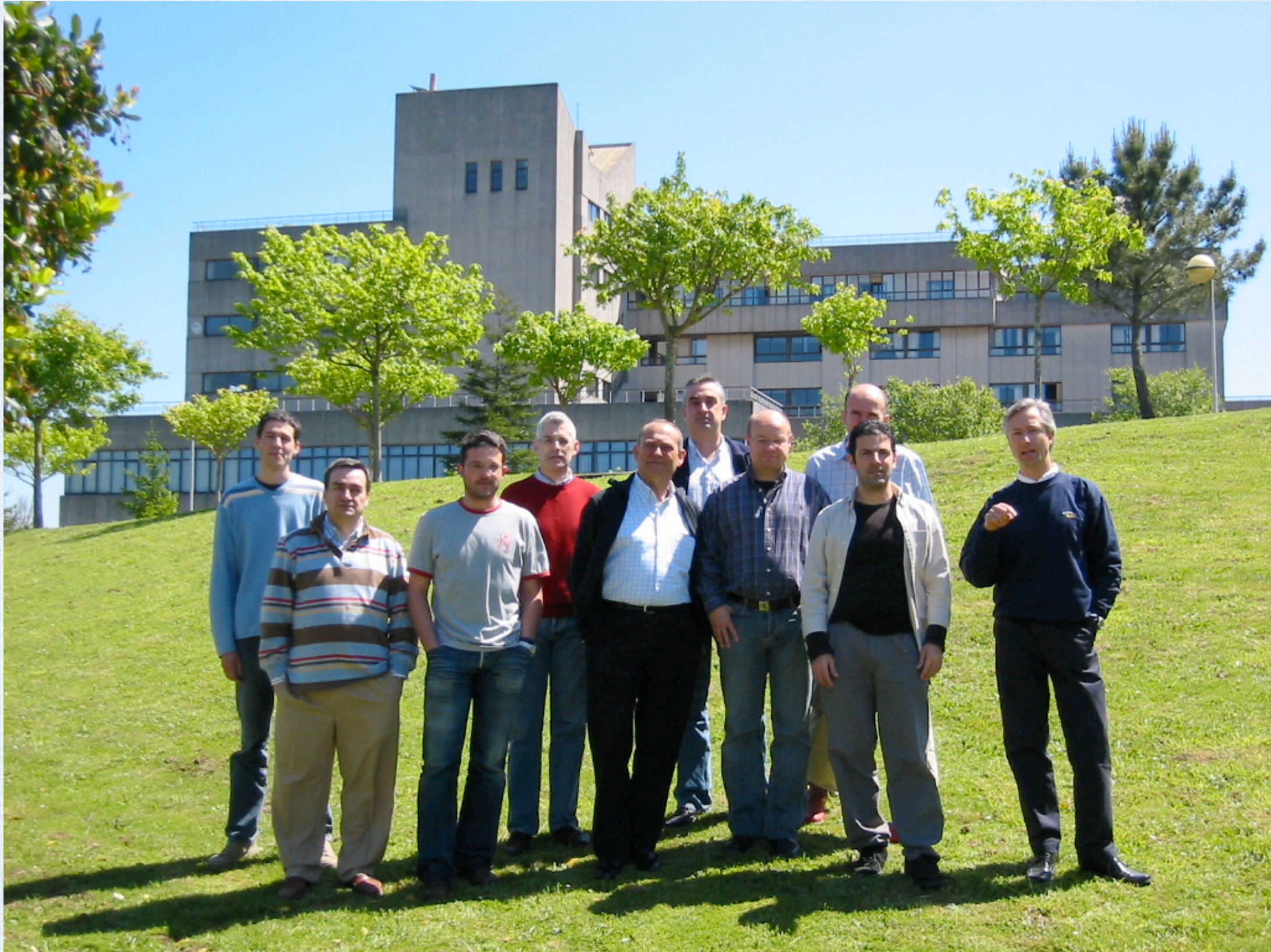
Elena González Ferreiro

Sergey Bondarenko

Carlos Pajares

Carlos Salgado

INCOMPLETE FAMILY PICTURE



LINES OF RESEARCH



Quenched Flavor in AdS / CFT



Unquenched Flavor in AdS / CFT



AdS / CFT and Quark-Gluon plasma



Supersymmetric branes, D-brane probes and intersections



AdS / CFT with reduced supersymmetry

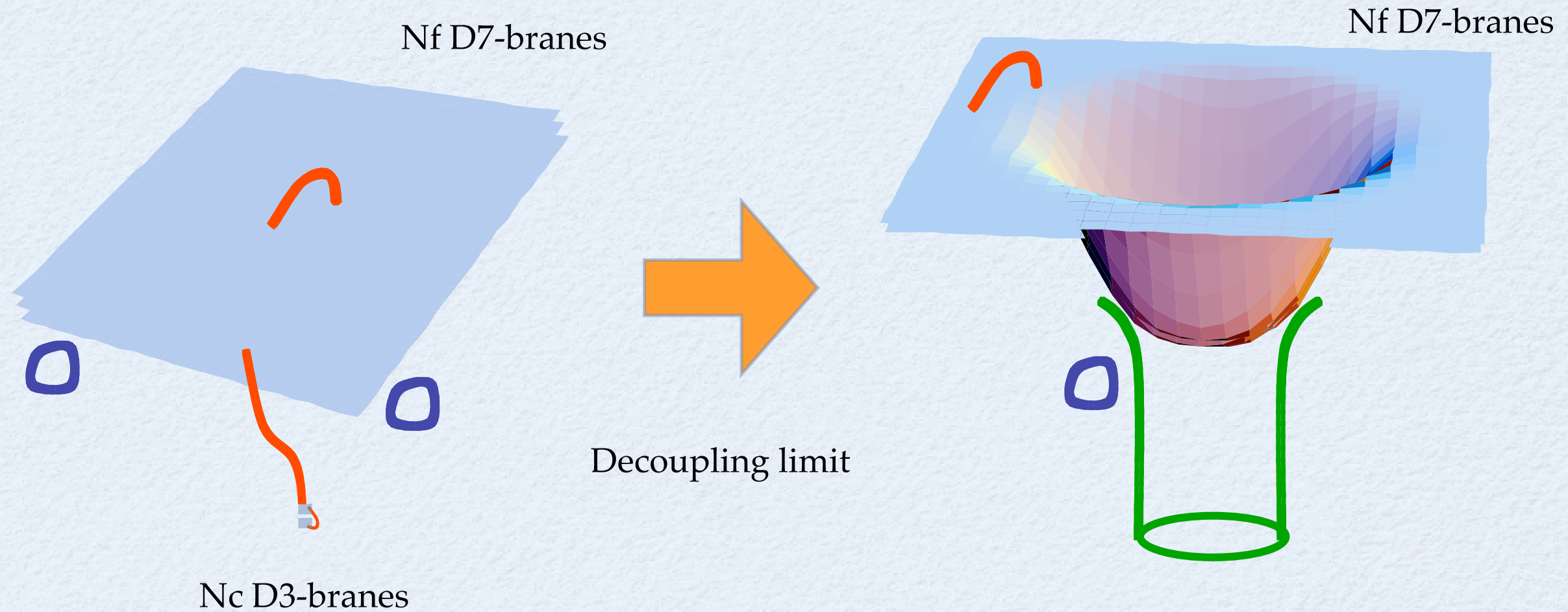


Chern-Simons supergravity

QUENCHED FLAVOR IN ADS/CFT

$N_f \ll N_c$

Karch-Katz, 2002



$$N_c \rightarrow \infty$$

$$g_s \rightarrow 0$$

$$N_f = \text{constant}$$

$$\lambda_7 \sim \lambda_3 l_s^4 N_f / N_c \rightarrow 0$$

$$\lambda_3 \sim g_s N_c \rightarrow \text{constant}$$

QUENCHED FLAVOR IN ADS/CFT

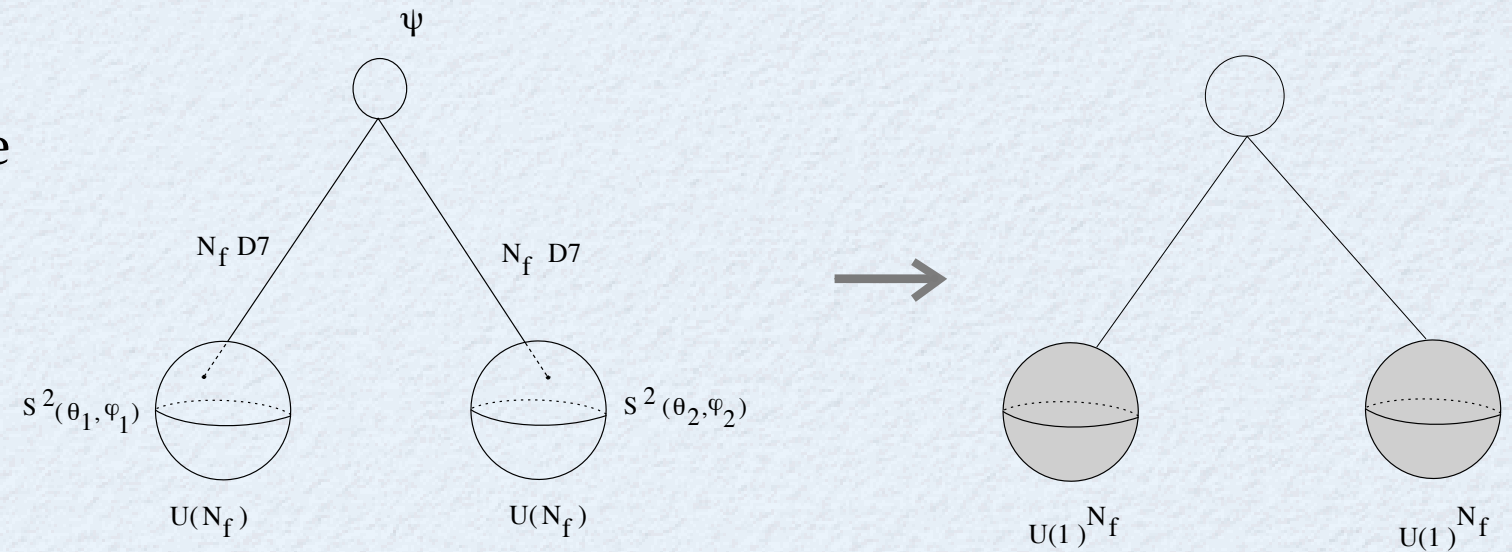
- ◆ **Flavoring the gravity dual of N=1 Yang-Mills with probes**
Carlos Núñez (MIT), Angel Paredes, Alfonso V. Ramallo
Journal of High Energy Physics 0312:024, 2003
- ◆ **Adding flavor to the gravity dual of non-commutative gauge theories**
Daniel Areán, Angel Paredes (Ecole Polytechnique), Alfonso V. Ramallo
Journal of High Energy Physics 0508:017, 2005
- ◆ **Adding open string modes to the gauge/gravity correspondence**
Alfonso V. Ramallo
*Modern Physics Letters A*21:1481, 2006
- ◆ **Mesons and Higgs branch in defect theories**
Daniel Areán, Alfonso V. Ramallo, Diego Rodriguez-Gomez (Oviedo)
*Physics Letters B*641:393, 2006
- ◆ **Holographic flavor on the Higgs branch**
Daniel Areán, Alfonso V. Ramallo, Diego Rodriguez-Gomez (Princeton)
Journal of High Energy Physics 0705:044, 2007

UNQUENCHED FLAVOR IN ADS/CFT

$$N_f \approx N_c$$

Casero-Nunez-Paredes, 2006

Flavor branes are smeared along their transverse directions. For example, in $AdS_5 \times T^{1,1}$,



◆ Unquenched flavors in the Klebanov-Witten model

Francesco Benini (Trieste), Felipe Canoura, Stefano Cremonesi (Trieste), Carlos Núñez (Swansea), Alfonso V. Ramallo

Journal of High Energy Physics 0702:090, 2007

◆ Backreacting flavors in the Klebanov-Strassler background

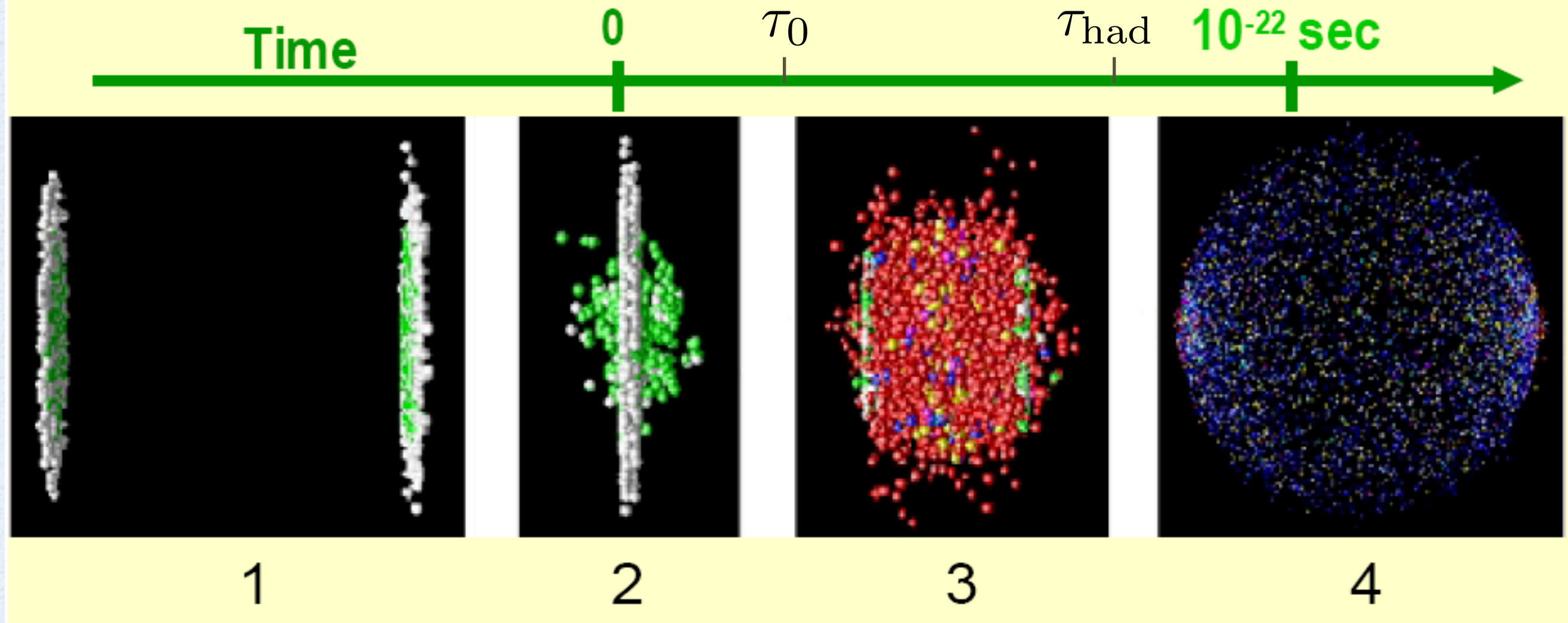
Francesco Benini (Trieste), Felipe Canoura, Stefano Cremonesi (Trieste), Carlos Núñez (Swansea), Alfonso V. Ramallo

arXiv:0706.1238 [hep-th]

ADS/CFT & QUARK-GLUON PLASMA

Exploring Heavy Ion Collisions... the Emerging Picture

The time sequence of a central (head-on) gold-gold collision at RHIC



Shear viscosity, jet quenching, drag force, meson melting, J/ψ suppression, speed of sound, screening lengths, diffusion coefficients, dynamical cooling and expansion, confinement/deconfinement transition, etc, etc

ADS/CFT & QUARK-GLUON PLASMA

- ◆ **Shear viscosity from R-charged AdS black holes**
Javier Mas
Journal of High Energy Physics 0603:016, 2006
- ◆ **Jet quenching at finite 't Hooft coupling and chemical potential from AdS/CFT**
Néstor Armesto (Santiago de Compostela), José D. Edelstein, Javier Mas
Journal of High Energy Physics 0609:039, 2006
- ◆ **The shear viscosity of the non-commutative plasma**
Karl Landsteiner (Madrid), Javier Mas
Journal of High Energy Physics 0707:088, 2007
- ◆ **Hydrodynamics from the Dp-brane**
Javier Mas, Javier Tarrío
Journal of High Energy Physics 0705:036, 2007
- ◆ **Holography and unquenched quark-gluon plasmas**
Gaetano Bertoldi (Swansea), Francesco Bigazzi (ULBrussels), Aldo Cotrone (Barcelona), José D. Edelstein
Physical Review D76:065007, 2007

SUSY BRANES & INTERSECTIONS



Supersymmetric intersections of M-branes and pp-waves

Javier Mas, Alfonso V. Ramallo

Journal of High Energy Physics 0305:021, 2003



Localized intersections of nonextremal p-branes and S-branes

José D. Edelstein, Javier Mas

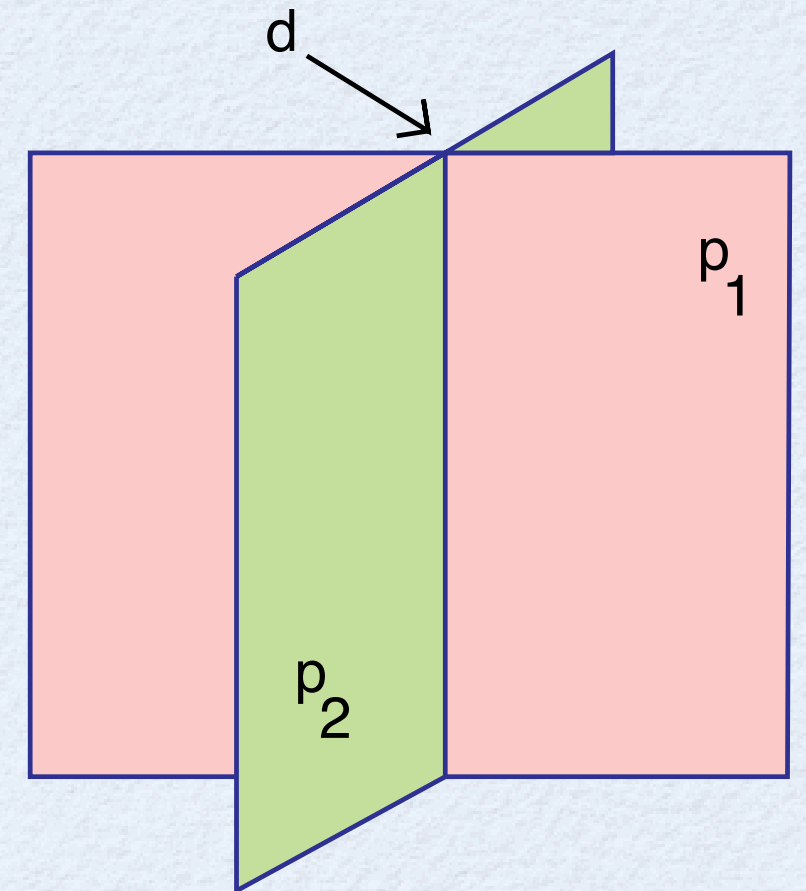
Journal of High Energy Physics 0406:015, 2004



Open string modes at brane intersections

Daniel Areán, Alfonso V. Ramallo

Journal of High Energy Physics 0604:037, 2006



D-BRANE PROBES

- ◆ **Supersymmetric probes on the conifold**
Daniel Areán, David E. Crooks, Alfonso V. Ramallo
Journal of High Energy Physics 0411:035, 2004
- ◆ **Supersymmetric branes on $AdS_5 \times Y^{p,q}$ and their field theory duals**
Felipe Canoura, José D. Edelstein, Leopoldo Pando Zayas (Michigan), Alfonso V. Ramallo, Diana Vaman (Michigan)
Journal of High Energy Physics 0603:101, 2006
- ◆ **Supersymmetric defects in the Maldacena-Núñez background**
Felipe Canoura, Angel Paredes (Ecole Polytechnique), Alfonso V. Ramallo
Journal of High Energy Physics 0509:032, 2005
- ◆ **D-brane probes on $L^{a,b,c}$ superconformal field theories**
Felipe Canoura, José D. Edelstein, Alfonso V. Ramallo
Journal of High Energy Physics 0609:038, 2006
- ◆ **Probe D-branes in superconformal field theories**
José D. Edelstein
Fortschritte der Physik 55:705, 2007

CHERN-SIMONS SUPERGRAVITY

Higher dimensional gravity is dictated, in general, by Lovelock theory

$$\mathcal{L} = \sum_{p=0}^{\lfloor \frac{D-1}{2} \rfloor} \alpha_p \mathcal{L}_p \quad \mathcal{L}_p = \epsilon_{a_1 \dots a_D} R^{a_1 a_2} \wedge \dots \wedge R^{a_{2p-1} a_{2p}} \wedge e^{a_{2p+1}} \wedge \dots \wedge e^{a_D}$$

There is a special case in which a given symmetry group (say, that dictated by the M-algebra) can be realized off-shell in odd-dimensional (say, eleven) dimensions

This suggests a possible connection between Chern-Simons supergravity and M-theory

- ◆ **(Super-)gravities of a different sort**
José D. Edelstein, Jorge Zanelli (CECS)
Journal of Physics: Conference Series 33:83, 2006

- ◆ **Lie-algebra expansions, Chern-Simons theories and the Einstein-Hilbert Lagrangian**
José D. Edelstein, Mokhar Hassaine (CECS & Talca), Ricardo Troncoso (CECS), Jorge Zanelli (CECS)
Physics Letters B640:278, 2006

ADS/CFT WITH REDUCED SUSY

- ◆ **Let's twist again: general metrics of $G(2)$ holonomy from gauged supergravity**
José D. Edelstein, Angel Paredes, Alfonso V. Ramallo
Journal of High Energy Physics 0301:011, 2003
- ◆ **Singularity resolution in gauged supergravity and conifold unification**
José D. Edelstein, Angel Paredes, Alfonso V. Ramallo
Physics Letters B554:197, 2003
- ◆ **Large N dualities from wrapped D-branes**
José D. Edelstein
Third International Sakharov Conference on Physics, Scientific World (Moscow), vol.II:388, 2003
- ◆ **Gauge/string duality in confining theories**
José D. Edelstein, Rubén Portugues (CECS)
Fortschritte der Physik 54:525, 2006
- ◆ **Getting $N=1$ super Yang-Mills from strings**
Paolo Merlatti
Journal of Physics: Conference Series 53:658, 2006
- ◆ **On the M-theory description of supersymmetric gluodynamics**
Felipe Canoura, Paolo Merlatti
Journal of High Energy Physics 0707:042, 2007

MISCELLANEOUS ACTIVITIES



Workshop on Gravitational Aspects of Strings and Branes

Gravity, Strings and Gauge Theories

Santiago de Compostela, 8-11 February 2006

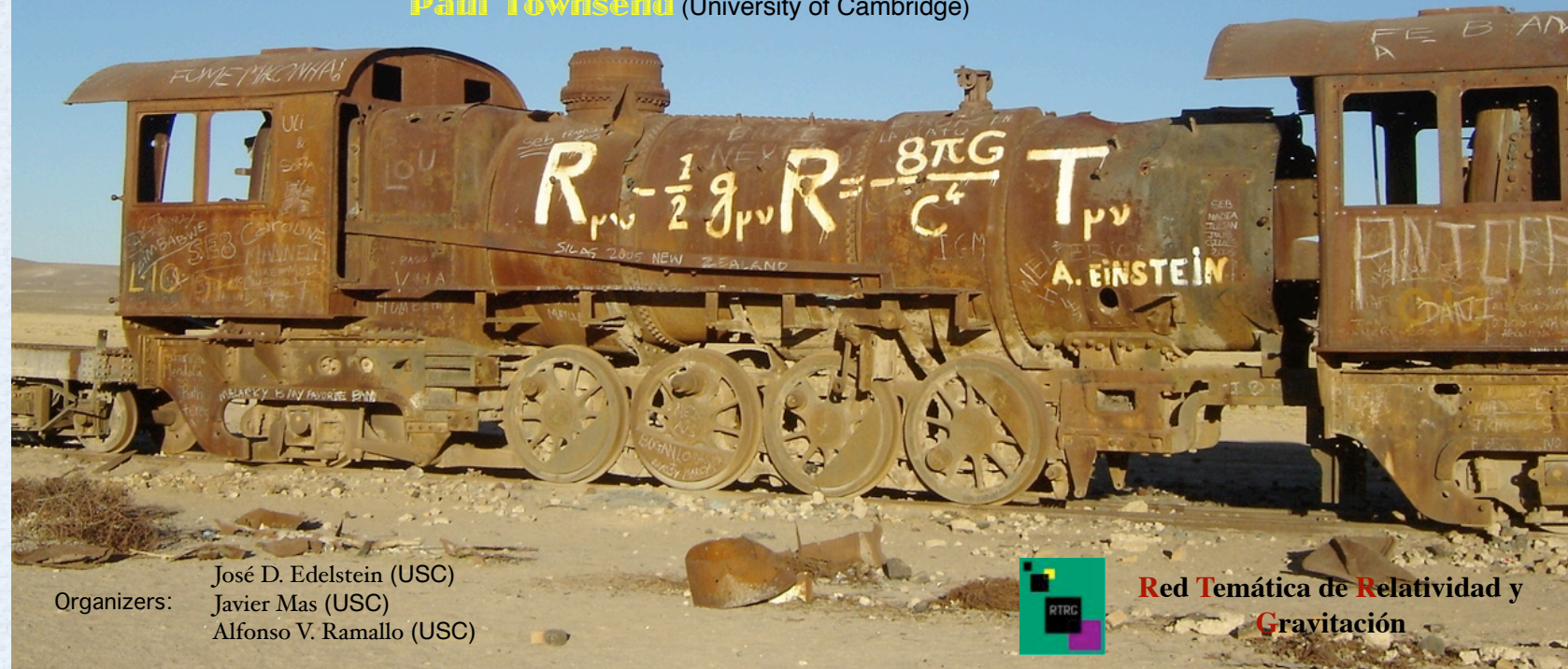
<http://fpmach1.usc.es/gsgt06/>

Invited Speakers:

David Berenstein (University of California, Santa Barbara)

Andrei Starinets (Perimeter Institute)

Paul Townsend (University of Cambridge)



Organizers:
José D. Edelstein (USC)
Javier Mas (USC)
Alfonso V. Ramallo (USC)



Red Temática de Relatividad y
Gravitación



Departamento de Física de Partículas

and

Instituto Gallego de Física de Altas Energías
(IGFAE)

Seminars and Courses (Theory)

2007/2008

19 Oct 07

Frank Wilczek (MIT)
TBA.

27 Sep 07

David García (ICN-UNAM)
Partonic energy loss due to collisions in a QCD finite medium (off-shell particles).

26 Sep 07

Nicolás Grandi (Univ. Nacional de La Plata)
A proposal for early time cosmology: The Cosmological Slingshot scenario.

11 Sep 07

Andrés Gomberoff (Univ. Andrés Bello)
Counting the negative eigenvalues of the three dimensional thermalon.

3 Sep 07

Grzegorz Wilk (Soltan Inst. for Nuclear Studies, Warsaw)
Fluctuations, correlations and non-extensivity.

Previous years

2004/2005 2005/2006 2005/2006